

EFFECTS OF BURNING AND CLIPPING ON FIVE BUNCHGRASSES IN EASTERN OREGON

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ABSTRACT.—Response of five perennial bunchgrasses following clipping and burning was evaluated in eastern Oregon. Burned plants were compared with clipped plants on several dates from spring to fall with respect to mortality and change in basal area. Basal area was generally reduced for one year but did not change the second year after defoliation. Treatments rarely affected yield. Burning in May was most detrimental, reducing basal area of all species. Fall clipping was least harmful, producing little or no change in basal area. Plant mortality was significant only for burned Thurber needlegrass (*Stipa thurberiana*).

Bunchgrasses comprise a major proportion of herbaceous vegetation in the Great Basin; yet little information is available regarding their response to defoliation. Furthermore, reports of bunchgrass response to fire and/or clipping are variable within and between species. Differences in defoliation effects are probably largely due to differences in growth form, phenology, season of treatment, and favorability of study years (Wright and Bailey 1982).

Bluebunch wheatgrass (*Agropyron spicatum*), Idaho fescue (*Festuca idahoensis*), junegrass (*Koeleria cristata*), bottlebrush squirreltail (*Sitanion hystrix*), and Thurber needlegrass (*Stipa thurberiana*) are dominant herbaceous species in eastern Oregon (botanical nomenclature follows Hitchcock and Cronquist [1973]). Published data concerning response of these species parallel that of most bunchgrasses in scarcity and variability. Appropriate management of these and other bunchgrass communities requires knowledge of their response to defoliation. The objective of this study was to evaluate the effects of fire on these five perennial bunchgrasses on eastern Oregon rangeland.

METHODS

The study area is located on Squaw Butte Experiment Station, 65 km west of Burns,

Oregon. Elevation is 1,370 m, and average annual precipitation is 29.4 cm. Precipitation during the study was 24.6 cm in 1976, 27.5 cm in 1977, and 28.0 cm in 1978. Soil on the study area is a fine-loamy, mixed, frigid Aridic Durixeroll.

A 1-ha area was fenced to exclude livestock, and 90 plants each of five species were marked with wire stakes. Ten plants received no defoliation treatment and were treated as controls for mortality assessment. Ten randomly selected plants were burned with an individual plant burner (Britton and Wright 1979) on each of three dates: 15 May, 15 June, and 11 November 1976. Time-temperature curves peaked at 200 C at 30 sec. Ten randomly selected plants were clipped to 1-cm stubble height on each of the three dates. These clipped plants served as controls for burning treatments to evaluate the effects of fire separately from the effects of aboveground biomass removal. An additional 10 plants were clipped on 27 August and 12 October to compare effects of defoliation during late summer and early fall with other defoliation dates.

Treatment effects were measured as percentage changes in basal area and yield. After treatment each plant was photographed to determine initial basal area (cm²). A wire grid (2.5 × 2.5 cm) was placed atop each plant base before photographing to provide a permanent record of basal area. Aboveground biomass

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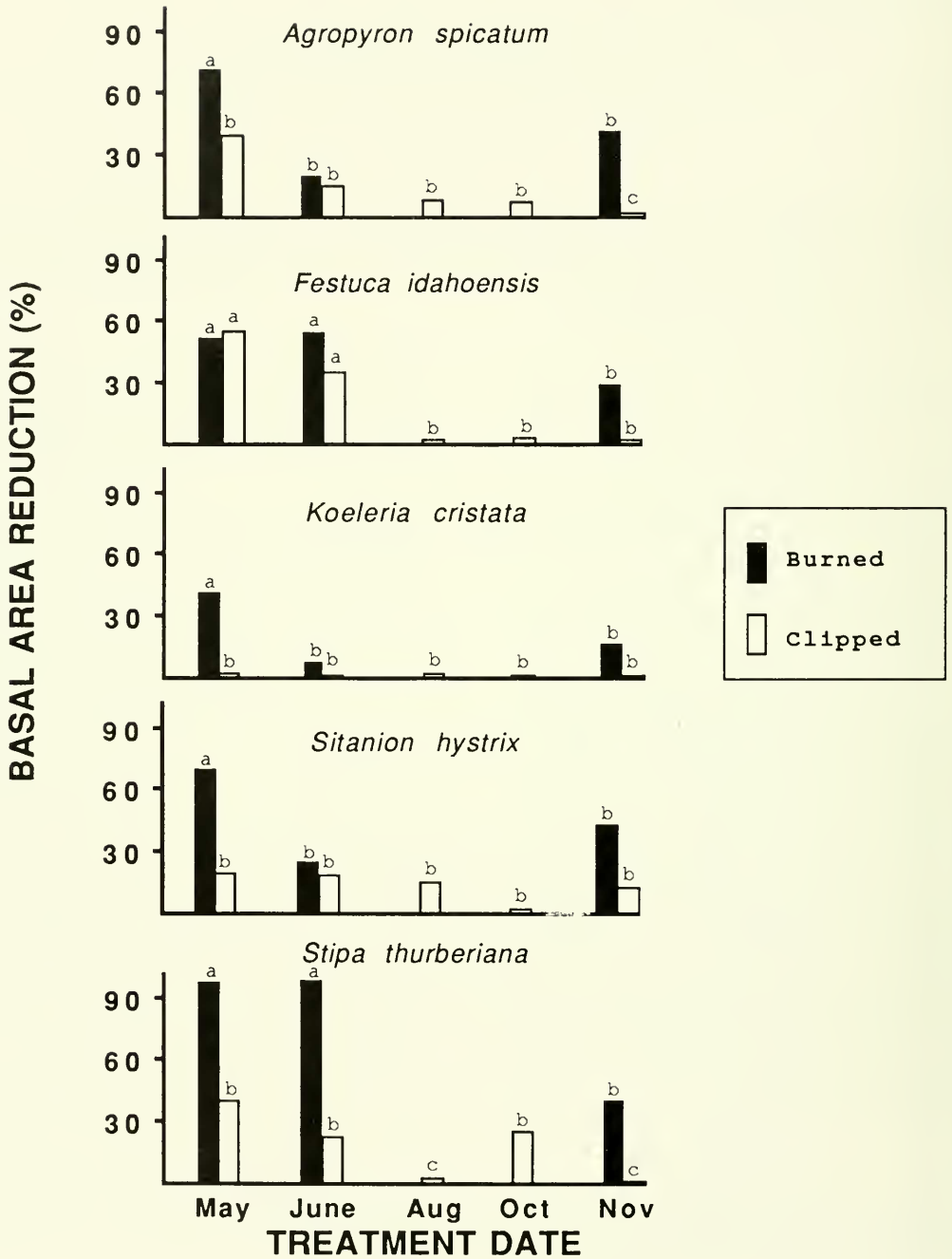


Fig. 1. Mean reduction in basal area of five bunchgrasses one year after burning or clipping in eastern Oregon. Plants were treated on various dates in 1976; basal area was measured immediately following treatment and in July of 1977 and 1978. Basal area reduction two years after burning rarely differed ($P > .05$) from 0%. Within a species, histograms marked with the same letter are not significantly different ($P > .05$).

was clipped in late July one and two growing seasons after treatment, and each plant was rephotographed at that time. Percentage change in basal area was calculated, and analysis of covariance (adjusted to initial plant basal area) was used to test for differences in basal area among treatments one year and two years posttreatment. Yield was expressed as grams per square decimeter of basal area to adjust for different plant sizes. Plants with no live tillers two years after treatment were assumed to be dead. Means were separated using Fisher's protected LSD test ($P = .05$).

RESULTS

Basal Area

Basal area generally declined the first year after treatment (Fig. 1). Bluebunch wheatgrass basal area decreased 45% one year after burning and 22% after clipping. May burning was especially damaging to basal area (-69%); by contrast, November clipping had no effect on basal area. Other treatment-date combinations were intermediate (mean = -32%) and did not differ. Effects of August and October clipping treatments (mean = -13%) were intermediate between effects of May and June clipping (mean = -28%) and November clipping (no change).

Idaho fescue basal area was affected by date of defoliation but did not differ between treatments. Defoliation in May and June reduced basal area by an average of 48%. Other treatment-date combinations did not significantly ($P > .05$) reduce basal area.

Basal area of junegrass was reduced 42% by burning in May. No other treatment-date combinations differed significantly from 0%.

Squirreltail basal area was reduced 71% by burning in May, which was a greater reduction than other treatment-date combinations (mean = -24%). Basal area change of plants clipped in August, October, and November did not differ significantly from 0%, indicating that squirreltail was resistant to late-season clipping.

Needlegrass basal area was reduced 93% by May and June burning, largely due to high mortality associated with early burns (May mortality = 50%, June mortality = 70%). August and November clipping treatments did not significantly affect basal area. Change in basal area did not differ between

other defoliation treatments (mean = -33%), which were intermediate between early-season burning and late-season (August, November) clipping treatments.

Subsequent (second-year) decreases in basal area of all species were slight and generally not significant ($P > .05$) and will not be discussed. Exceptions were (1) junegrass, which decreased the second year following burning (mean = -21% from first year to second) or clipping (mean = -18%) on all dates; (2) squirreltail, which decreased following burning in May (-53%) and June (-42%); and (3) needlegrass, which decreased following clipping in August (-27%).

Yield

Yield (adjusted for basal area) of bluebunch wheatgrass was not affected by method or date of defoliation. First-year yield was 4.2 g/dm^2 ; second-year yield was 7.3 g/dm^2 (Fig. 2).

First-year yield of Idaho fescue was reduced by date of defoliation, but clipping and burning did not differentially influence yield. Plants defoliated in May produced 6.1 g/dm^2 dry matter, compared with a mean yield of 3.1 g/dm^2 for all other dates. Yields from supplementary August and October clipping treatments did not differ from June and November yields. Second-year yield (mean = 8.0 g/dm^2) was not affected by date or method of defoliation.

First-year yield of junegrass was affected by defoliation date in a manner similar to that of Idaho fescue. Defoliation in May resulted in 2.7 g/dm^2 dry matter production, compared with 1.5 g/dm^2 following defoliation in November. Yield following clipping in October was 1.8 g/dm^2 , which was lower than yield following May defoliations. Yields from June and August treatments were intermediate (mean = 2.3 g/dm^2) and did not differ from yields on other dates. Second-year yields were unaffected by date or method of defoliation (mean = 7.0 g/dm^2).

Squirreltail yield was lower one year after burning (1.6 g/dm^2) than after clipping (5.8 g/dm^2) in May. A significant treatment \times date interaction precluded comparisons across all dates. Yields following burning and clipping did not differ on other dates, and date of defoliation did not affect yield of clipped plants (mean = 4.7 g/dm^2). Second-year yield was

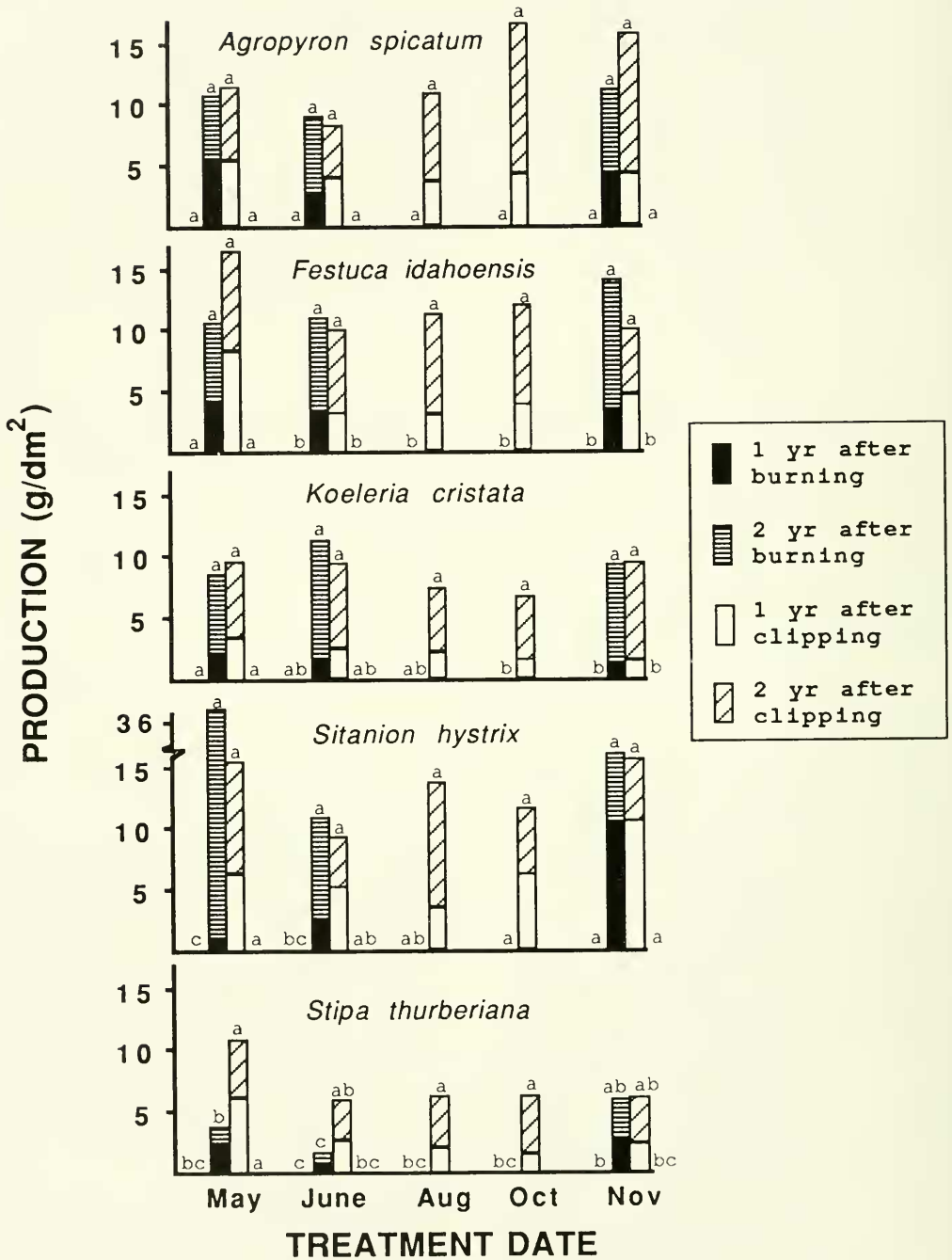


Fig. 2. Mean production of five bunchgrasses one and two years after burning or clipping in eastern Oregon. Plants were treated on various dates in 1976; aboveground biomass was clipped in July of 1977 and 1978. Within a species, histograms marked with the same letter are not significantly different ($P > .05$).

not affected by date or method of defoliation (mean = 12.3 g/dm²).

First-year yield of needlegrass was affected by date and method of defoliation; the date \times treatment interaction was also significant. Yield following clipping in May was higher than any other date-treatment combination (6.4 g/dm²). Mean yield following November burning was higher than after June burning (2.6 vs. 0.6 g/dm²), largely due to higher survival of fall-burned plants (90 vs. 30%). First-year yields of other date-treatment combinations were intermediate (1.9–2.5 g/dm²) and did not differ. Needlegrass was the only species in which second-year yield was affected by treatment. Mean second-year yields of burned and clipped plants were 2.0 and 4.2 g/dm², respectively. Increased mortality of burned plants (mean = 57%) accounted for the difference. Second-year yield was not affected by date of defoliation. Needlegrass was the only species in which significant mortality occurred. Burning in May, June, and November resulted in 50%, 70%, and 10% mortality, respectively. No control or clipped plants died.

DISCUSSION

Bluebunch wheatgrass was relatively tolerant to all treatments except May burning. Basal area declined more following burning than clipping, but yield responses were similar between treatments. Similarly, Uresk et al. (1976) reported decreased basal area and increased yield one year after a wildfire in eastern Washington. Conrad and Poulton (1966) found a 29% reduction in basal area one year after a wildfire in the same area. Wright (1985) summarized the literature on grass response to fire in sagebrush-grass communities and concluded that bluebunch wheatgrass is slightly affected by burning, with yield returning to preburn levels in one to three years.

Idaho fescue appeared to be less susceptible to defoliation than has been reported previously. Basal area and mortality were not affected by late summer or fall defoliation. Furthermore, burning and clipping had similar effects on plants. Wright et al. (1979) summarized studies by Pechanec and Stewart (1944), Blaisdell (1953), Countryman and Cornelius (1957), Conrad and Poulton (1966), and

Harniss and Murray (1973), stating that "the majority of evidence indicates that Idaho fescue is severely damaged regardless of when or where it is burned." However, Wright (1971) found increased resistance to burn damage from late July through late September, and attributed the altered resistance to low energy reserves and high respiration demands during late summer. Daubenmire (1970, 1987) reported mixed results for wildfires in eastern Washington. Wright and Klemmedson (1965) reported minimal damage to Idaho fescue after late-summer and fall fires; data from this study indicate that late-season defoliation may not be harmful at all. Higher yields of plants defoliated in May are attributable to (1) decreased basal area with no decrease in yield per plant, and (2) decreased growing period for plants treated later in the growing season. Plants treated after 15 May had begun growth at the time of defoliation. Second-year yield was not affected by date or method of defoliation, further indicating that the additional growing period associated with early defoliation produced the observed differences in first-year yield. Britton et al. (1983) found that first-year yields of Idaho fescue following August burning were 25% lower than yields following burning in October.

Junegrass was tolerant to all treatments except May burning. Basal area decreased in the second year after defoliation, although production increased. Wright et al. (1979) attributed junegrass's resistance to the relatively small size of typical junegrass plants. Relatively high yields following early defoliation and low yields following late defoliation support the hypothesis that yield is influenced primarily by length of growing season following defoliation. Further support was provided by second-year yields that were unaffected by date or method of defoliation.

Squirreltail was moderately affected by defoliation, with significant basal area decreases in all treatments except late-season clipping. May burning was most detrimental to basal area. Wright (1971) reported similar results in southern Idaho and attributed squirreltail's late-season tolerance to clipping to summer dormancy (Wright 1967). Young and Miller (1985) found no change in basal area, but increases in above- and belowground yield, following July burning. Squirreltail's resistance to fire derives from plant growth form

(coarse stems with little leafy material) and small size (which precludes development of dead centers) (Wright and Bailey 1982, Daubenmire 1987). Since basal area decreased by an average of 47% the second year after early-season burns, increased abundance on burned areas (Blaisdell 1953, Barney and Frischknecht 1974) probably results from squirreltail's ability to survive and subsequently invade sites previously occupied by other perennial plants, and not from increased size of individual plants. Lack of differences in yield two years after defoliation indicated that response of squirreltail, along with bluebunch wheatgrass, Idaho fescue, and junegrass, varied independently of the method of defoliation.

Needlegrass was severely damaged by all defoliation treatments. Burning was particularly harmful, increasing mortality and reducing mean basal area and yield. Uresk et al. (1976) reported a 53% reduction in basal area following an August wildfire; recovery was not complete three years later (Uresk et al. 1980). Wright et al. (1979) concluded that Thurber needlegrass is probably the least resistant needlegrass. Early-season clipping was more damaging to needlegrass than late-season clipping in this study. Plants responded similarly to May, June, and August clipping and November burning, but later clipping treatments had no measurable effect.

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